NASA TLX Task Load Index

Evaluation Program (Workload.exe)

Version 2.2

User Guide

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Executive Summary

The NASA Task Load Index (TLX) provides a standard and widely used protocol for assessing a subject's perceptions of the difficulty they experienced while performing experimental tasks. The index is defined in terms of six rating scales that decompose the difficulty subjects experienced along different psychological axes. The TLX protocol as originally developed called for a paper-and-pencil evaluation to collect the information necessary for computation of the index. A more convenient DOS-based program written in Turbo Pascal automated the original version, providing a simple user interface. This guide describes a new implementation of this software, designed to run under recent versions of the Microsoft Windows™ operating systems, augmented with several new features to help organize and simplify the collection of TLX data. Data may be saved to a comma-separated variable text file for further processing.

Three additional, optional rating scales may be selected to provide greater diagnostic assessment than that available from the original method. These scales include ratings for the Visual and Auditory demands as well as an overall workload perception.

The program is functional but should still be considered under development. It provides DRDC with a tool to quickly record NASA TLX subjective ratings from subject matter experts or test subjects using a laptop computer and a mouse, then save the results in a format suitable for analysis in spreadsheets or statistical packages.

Résumé

L'indice de charge de tâches (TLX) de la NASA constitue un protocole normalisé et largement utilisé pour l'évaluation des perceptions de la difficulté éprouvée par des sujets dans l'exécution de tâches expérimentales. L'indice est défini en fonction de six échelles d'évaluation qui décomposent la difficulté éprouvée par les sujets selon différents axes psychologiques. Dans le protocole TLX élaboré initialement, on devait effectuer une évaluation avec un crayon et du papier pour recueillir les données nécessaires au calcul de l'indice. La version initiale a par la suite été remplacée par un programme DOS plus pratique écrit en Turbo Pascal, qui offrait une interface utilisateur simple et automatisait les calculs. Le présent guide sommaire décrit la prochaine génération de ce logiciel, conçu pour tourner sur les plus récentes versions du système d'exploitation Microsoft WindowsTM et comprenant plusieurs nouvelles options destinées à simplifier l'organisation et la collecte des données relatives à l'indice TLX. Les données peuvent être sauvegardées dans un fichier-texte de variables séparées par une virgule en vue d'un traitement ultérieur.

Trois échelles d'évaluation additionnelles peuvent être sélectionnées en option pour permettre une évaluation diagnostique supérieure à celle qui peut être effectuée avec la méthode originale. Ces échelles comprennent des évaluations de l'effort visuel et de l'effort auditif ainsi que de la perception de la charge de travail globale.

Le programme est en état de service mais il devrait être considéré comme étant encore en phase de développement. Il fournit à RDDC un outil permettant d'enregistrer rapidement des évaluations subjectives de l'indice TLX de la NASA fournies par des experts en la matière ou des sujets soumis à des tests, à l'aide d'un ordinateur portatif et d'une souris, puis de sauvegarder les résultats dans un format approprié pour l'analyse dans des tableurs ou des logiciels statistiques.

1 Introduction

The NASA Task Load Index (TLX) provides a standard and widely used protocol for assessing a subject's perceptions of the difficulty they experienced while performing experimental tasks. The index is defined in terms of six rating scales that decompose the difficulty subjects experienced along different psychological axes.

Evaluation of the TLX proceeds in two steps. The first, usually conducted once, before or after the experimental trials, orders the six NASA TLX scales according to each subject's perception of their relative importance. Subjects select the more important of each scale in a paired-comparison of all the unique pairs of scales. The second step, conducted after each experimental trial or after all trials, records a quantitative measure or rating of the task difficulty along each of the six different scales. Subjects are asked to mark a line between two extremes (for example, "Good" vs. "Poor") that corresponds to their perception of the tasks demands or their own performance. An overall workload index is then computed for each trial condition by summing the ratings collected in the second step, weighted according to their relevance as established by the paired-comparisons in the first step.

The TLX protocol as originally developed called for a paper-and-pencil evaluation to collect the information necessary for computation of the index. A DOS-based program written in Turbo Pascal was developed to automate the process. This guide describes a new implementation of this procedure designed to run under recent versions of the Microsoft Windows™ operating system, adding several new features to help organize and simplify the collection of TLX data.

The program, called "Workload", provides four major levels of functionality

- A *master control panel* that can be used to create and manage a list of experiments as well as a list of experimental subjects associated with each experiment;
- An *experiment template editor* that can be used to define and describe each set of weight and rating evaluations that will be conducted for each subject according to an experimental design;
- *Weights and ratings evaluation dialogs* that provide a structured interface for the subject to record their impressions of the task in terms of the TLX factors; and
- A *results dialog* that displays the weights and ratings, and computes the TLX index itself, while also allowing the results to be saved to a spreadsheet file.

Workload manages experiments and subjects hierarchically, with experiments defined at the top level and subjects defined under experiments. Each experiment has associated with it a *template* corresponding to the experimental design, including all of the trials that the subject will rate. When a new subject is defined, the file inherits all of the settings in the associated experiment's template. Thus, the usual procedure is

1. Create a new experiment.
2. Edit the template for the experiment, defining all experimental conditions under which weight and rating evaluations should take place.
3. Create new subjects. They will inherit all the definitions in the experiment template.
4. Have the subjects evaluate the weights and ratings for each set of conditions.
5. View and/or save the results.

The following sections in this User Guide explain how to perform each of the above tasks.

2 Installation

Installation of the software is a simple matter of copying the application program from the distribution CD to your computer's hard drive. To proceed with the installation, first locate the application program on the distribution CD - the program is called "Workload", and its icon consists of the three letters "TLX" in red and turquoise. Next, drag the icon from the CD to your desktop or to the folder on your hard drive where you would like the program to reside. Alternately, you can use the Windows Explorer copy and paste functions to create a copy of the software in the desired location.

Note that because the software was copied from a CD, it will initially have "Read-only" status and you will not be able to delete it. If you wish to delete the program, click on it with the right mouse button and choose Properties from the pop-up menu. Click on the Read-only box to clear it and close the Properties dialog. You should now be able to delete the program.

The program automatically saves the results of successful user actions; usually the user is not required to manually save changes or entered data, although irrevocable actions such as deleting subjects or trials will prompt the user for confirmation before the action is carried out.

3 The Master Control Panel

Start the Workload program by double-clicking on its icon. If this is the first time you have run the program in its current location, you will be prompted to allow the program to create an **Experiments** sub-directory where all data files must be kept. Click OK to proceed. If you do not want this directory created, click Cancel and the program will terminate, but you will not be able to use the program until this directory has been created.

> **NOTE**: You should never add to, edit, or delete files contained within the Experiments directory directly; all user actions should be through the Master Control Panel instead. You do not need to explicitly save changes that you have made while using the Workload program. The software does this automatically each time you complete an action.

The Workload **Master Control Panel** will open (Figure 1). This window provides a structured interface to guide you through the various tasks involved in using the Workload program, and is where you will perform all management of experiment and subject files. You can resize this window to suit your preferences, and the new size will remain persistent between sessions.

The Master Control Panel is separated into two halves, left and right. The left half contains a set of buttons for each of the main tasks that you can perform with the program, while the right half shows the lists of available experiments and subjects. Large red prompts at the top will provide helpful messages to guide you through execution of the various Workload tasks.

To exit the program at any time, press the large button entitled **Exit the Workload Program** that runs along the bottom of the window. A warning will prompt you for confirmation before exiting. No data will be lost if you decide to exit.

The available tasks are broken into two separate groups. Tasks related to the management of experiments, colour-coded blue, appear toward the top of the window. Tasks related to the management of subjects within experiments, colour-coded green, appear toward the bottom.

To select and execute one of the tasks listed in the left half of the window, simply click on the corresponding button. In some cases, you may have to select an experiment and possibly a subject before the task can be executed. For example, you must select an experiment before creating or viewing a list of subjects for the experiment or before clicking the **Delete an Experiment Template** button, so Workload will know which experiment to delete. If you click a task button without having first made the necessary selection, a large, red blinking message at the upper right of the window will instruct you to make the required selection. The steps required for each task are described in the following sections.

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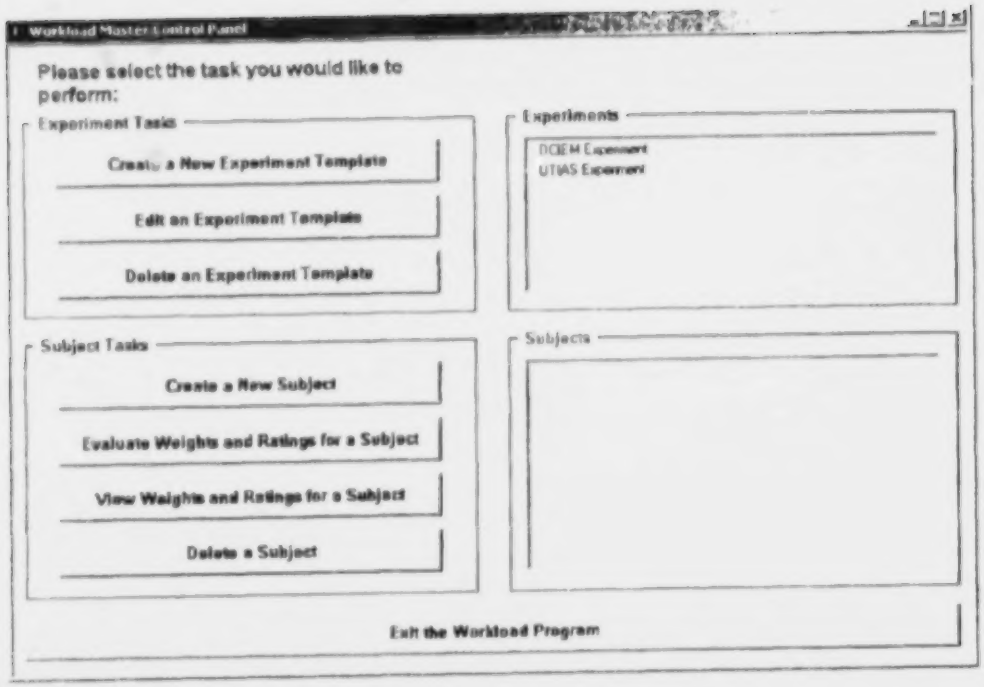


Figure 1. The Workload Master Control Panel.

3.1 Experiment Tasks

As noted above, each experiment has associated with it a *template* that is used to define when the paired-comparison process will occur as well as the experimental conditions that the subjects will rate. As each subject's file is created, it inherits all of the settings in the associated experiment's template. *Experiment tasks* involve creating, editing, or deleting experiment templates. The following sub-sections describe these tasks.

3.1.1 Creating a new experiment template

1) To create a new experiment template, click the **Create a New Experiment Template** button.

2) Enter a new name for the experiment where indicated.

3) Press the **Enter** key to accept the new name, or the **Escape** key to abort creation of the new experiment.

You can change the name you have entered later at any time by clicking once on it and waiting for the editor box to open. You do not need to explicitly save new experiments that you have added. The software does this automatically each time you complete an action.

3.1.2 Editing an experiment template

Once an experiment has been created, you can run the template editor to create or edit its contents. To edit an existing experiment's template:

1) Select it in the **Experiments** window.

2) Click the **Edit an Experiment Template** button to the left of the window. Alternately, you may simply double-click on an experiment in the **Experiments** window to open the editor.

3) The Template Editor window will open. See section **4 Editing Experiment Templates** for a guide to using the Template Editor.

3.1.3 Deleting an experiment template

To delete an existing experiment's template:

1) Select it in the **Experiments** window.

2) Click the **Delete an Experiment Template** button to the left of the window. You will be prompted for confirmation before the experiment is deleted.

3.2 Subject Tasks

Once experiments have been created, you may begin to add subjects to each independently; separate subject profiles must be created in each experiment even if the same subject participates in more than one experiment. *Subject tasks* consist of the creation, evaluation, viewing, and deletion of subject files. You will normally have completed the specification of the subject's experiment using the Experiment Template Editor prior to adding any subjects. The execution of subject-oriented tasks is described in the following sub-sections.

Prior to executing any of these tasks, you must first select the associated experiment in the **Experiments** list. Once this is done, the **Subjects** window will become enabled and will show the subjects currently associated with this experiment.

3.2.1 Adding a subject to an experiment

To add a new subject to an experiment

1) Select the experiment in the Experiments list.

2) Click the Create a New Subject button to the left.

3) Enter the new subject's initials where indicated.

4) Press the **Enter** key to accept the initials, or the **Escape** key to abort creation of the new subject.

You can change the initials you have entered later at any time by clicking once on them and waiting for the editor box to open. You do not need to explicitly save new subjects that you have added. The software does this automatically each time you complete an action.

3.2.2 Recording a subject's assessment of task load

To begin the subjective ratings

1) Select the subject's experiment in the **Experiments** window.

2) Select the subject in the **Subjects** window.

3) Click the **Evaluate Weights and Ratings for a Subject** button to the left of the window. Alternately, you may simply double-click on a subject's initials in the **Subjects** window to open the window.

4) The Subject Evaluation window will open. See Section **5 Evaluating A Subject's Assessment Of Task Load** for a guide to using the Subject Evaluation window.

3.2.3 Viewing a subject's results

Once a subject has rated a task, you can invoke the Subject Viewer to inspect the results. This viewer provides a subset of the functions available in the Subject Evaluation window. To view a subject's results

1) Select the subject's experiment in the **Experiments** window.

2) Select the subject to view in the **Subjects** window.

3) Click the **View Weights and Ratings for a Subject** button to the left of the window.

4) The Subject Viewer window will open. See **Section 6 Viewing And Saving The TLX Score And Summary Data** for a guide to using the Subject Viewer window.

3.2.4 Deleting a subject

To delete a subject from an experiment

1) Select the experiment in the **Experiments** window.

2) Select the subject to delete in the **Subjects** window.

3) Click the **Delete a Subject** button to the left of the window. You will be prompted for confirmation before the subject is deleted.

4 Editing Experiment Templates

The sets of weights and ratings for each subject in the experiment are defined in the Experiment Template window. For instructions on opening the Experiment Template Editor, see Section 3.1.2.

Once the **Experiment Template Editor** window is opened, headings near the top of the window will indicate that you are in the Template Editor, and will tell you which experiment is currently being edited. The main heading appears in blue, which is the colour-code for experiment-oriented tasks (Figure 2).

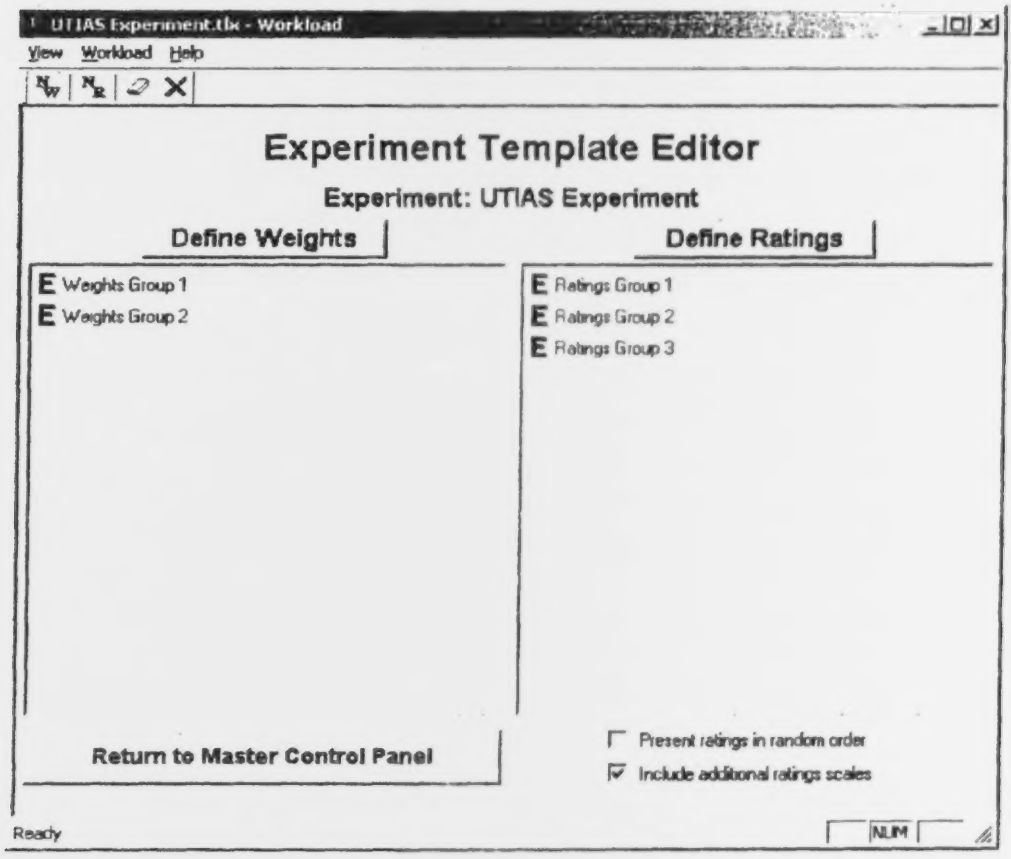


Figure 2. The Experiment Template Editor window.

To leave the Template Editor and return to the **Master Control Panel**, click the button entitled **Return to Master Control Panel** at the bottom of the window.

The Template Editor is separated into two panes, one on the left for **Weights** and one on the right for **Ratings**. These are where you will define the experimental conditions for which weight and rating evaluations are required. Typically, you will define several ratings entries for each weights entry, since ratings are generally evaluated after each experimental trial, while typically only one set of weights are created for a given set of experimental conditions. Several sets of weights may be evaluated for each experiment, however, the analyst must use them consistently for all subjects when computing an overall TLX workload score.

As noted earlier, you will generally define the weights and ratings for an experiment before creating any subjects for the experiment. When subjects are created later, all the contents of the experiment template are copied into the new subject file. However, if you do make a change to an experiment template after subjects have already been created for the experiment, then after each change to the template, you will be asked if you want to update the existing subjects' profiles. If the change you are making would require the deletion of existing subject data (for example deleting a weights entry), then you will be further prompted to make sure this is what you want to do.

The Template Editor allows you to create, edit the names of, and delete, either weights or ratings. Each of these functions is invoked by choosing an entry in **Workload** drop-down menu at the top left of the window, or by clicking the corresponding toolbar button. (To find out what each toolbar button does, hold the mouse pointer over it for a second and a tool tip will appear indicating its function, with a longer description appearing in the status bar at the bottom of the window). The following sub-sections describe each of these tasks in detail.

4.1 Weights

Each Weights entry may be associated with one or more experimental conditions. Subjects will make a series of pair-wise comparisons between the relative importance of the six TLX factors or scales. Each Weights entry should be give a descriptive name that denotes when it is recorded if several sets of weights are evaluated.

4.1.1 Creating new Weights

To create a new Weights entry:

1) Choose **New Weights Group** from the **Workload** menu, click the corresponding toolbar button (the one titled $^{N}_{W}$), or click on the **Define Weights** button above the **Weights** list.

2) A new entry will appear in the **Weights** list with a blue "**E**" beside it, and highlighted text prompting you to enter a name for this set of weights. The name you enter should describe the experimental conditions or settings for which these weights will be evaluated. Enter a new name.

3) Press the **Enter** key to accept the name, or the **Escape** key to abort creation of the weights entry.

You can change the name you have entered later at any time by clicking once on the weights entry and waiting for the editor box to open. You do not need to explicitly save new weights that you have created while using the Workload program. The software does this automatically each time you complete an action.

4.1.2 Deleting weights

The Delete command in the Workload menu and the corresponding toolbar button (a red X) will become enabled only after one or more Weights entries have been selected. To delete one or more weights entries:

1) Select one or more weights entries that you would like to delete. Hold the **Shift** key down to select a range of weights, or the **Ctrl** key to select multiple weights one at a time.

2) Choose **Delete** from the Workload menu or click the toolbar button (a red **X**).

3) You will be prompted for confirmation before the entry is deleted.

4.1.3 Erasing Weights

Erasing Weights from the Template Editor is an advanced subject file management function and should be used with extreme caution; data may be lost.

The Erase Weights function erases the data recorded from all subjects for a given Weights entry, without removing the entry itself. In effect, it changes the status of the selected Weights entries in all subject files from completed to not completed. It does nothing to the experiment template itself, since individual subject data is never associated with an experiment template. To erase recorded data from all subjects for one or more weights entries:

1) Select one or more Weights entries that you would like to erase. Hold the **Shift** key down to select a range of Weights, or the **Ctrl** key to select multiple Weights one at a time.

2) Choose **Erase** from the **Workload** menu or click the toolbar button (a picture of an eraser).

3) If Workload finds any subject files for which recorded data exists and will be erased, you will be prompted for confirmation before proceeding.

4.2 Ratings

Each Ratings entry is associated with a unique set of experimental conditions that each subject will be required to rate subjectively. The name given to a ratings entry will generally be a concise description of the corresponding experimental condition .

4.2.1 Creating ratings

To create a new ratings entry:

1) Choose **New Ratings** from the **Workload** menu, click the corresponding toolbar button (the one titled $^{N}_{R}$), or click the **Define Ratings** button above the **Ratings** list.

2) A new entry will appear in the **Ratings** list with a blue "**E**" beside it, with highlighted text prompting you to enter a name for this set of ratings. The name you enter should describe the experimental conditions or settings for which these ratings will be evaluated. Enter a new name.

3) Press the **Enter** key to accept the name, or the **Escape** key to abort creation of the ratings entry.

You can change the Ratings' names at any time by clicking once on an entry and waiting for the editor box to open. You do not need to explicitly save newly defined Ratings as the software does this automatically each time you successfully complete an action.

4.2.2 Deleting ratings

The Delete command in the Workload menu and the corresponding toolbar button (a red X) will become enabled once one or more ratings entries is selected. To delete one or more ratings entries

1) Select one or more ratings entries that you would like to delete. Hold the **Shift** key down to select a range of ratings, or the **Ctrl** key to select multiple ratings one at a time.

2) Choose **Delete** from the **Workload** menu or click the toolbar button (a red **X**).

3) You will be prompted for confirmation before the entry is deleted.

4.2.3 Erasing Ratings

Erasing Ratings from the Template Editor is an advanced subject file management function and must be used with extreme caution; data may be lost.

The Erase Ratings function erases the data recorded from all subjects for a given Ratings entry, without removing the entry itself. In effect, it changes the status of the selected Ratings entries in all subject files from completed to not completed. It does nothing to the experiment template itself, since individual subject data is never associated with an experiment template. To erase recorded data from all subjects for one or more ratings entries:

1) Select one or more ratings entries that you would like to erase. Hold the **Shift** key down to select a range of ratings, or the **Ctrl** key to select multiple ratings one at a time.

2) Choose **Erase** from the **Workload** menu or click the toolbar button (a picture of an eraser).

3) If Workload finds any subject files for which recorded data exists and will be erased, you will be prompted for confirmation before proceeding.

4.2.4 Setting optional ratings properties

The Workload program provides two additional properties that affect the evaluation of ratings. The first of these determines whether the ratings will be presented to the subject in random order, the recommended procedure, or in the usual fixed order defined by the original TLX protocol. The second determines whether three additional ratings assessing visual demand, auditory demand, and a univariate global workload will be added to the base TLX set of six scales; these three additional scales are not used in the calculation of the NASA TLX workload rating.

To activate or deactivate either of these features:

1) Locate the corresponding checkbox at the bottom right of the window. If an X appears in it, it is activated. If there is no X, it is deactivated.

2) Click on the checkbox to change its state. It switches back and forth between activated and deactivated each time you click it.

The program default for these settings has the random ratings setting on, and the additional ratings setting off. However, any change you make to these settings will be recorded as the new default, and will be persistent between sessions.

NOTE: When activating the additional ratings feature, the green checkmarks beside some ratings in the Evaluation Window may be replaced by red question marks, to indicate that there are now three more ratings to be evaluated. The original six ratings already recorded will be left intact, and subsequent evaluations will begin at the first of the three new incomplete ratings.

5 Evaluating A Subject's Assessment Of Task Load

The **Evaluate Subject Weights and Ratings** window is where you will record the data from each subject, for each of the Weights and Ratings entries recorded in the experiment's template (Figure 3). For instructions on opening the Subject Evaluation window, see Section 3.2.2.

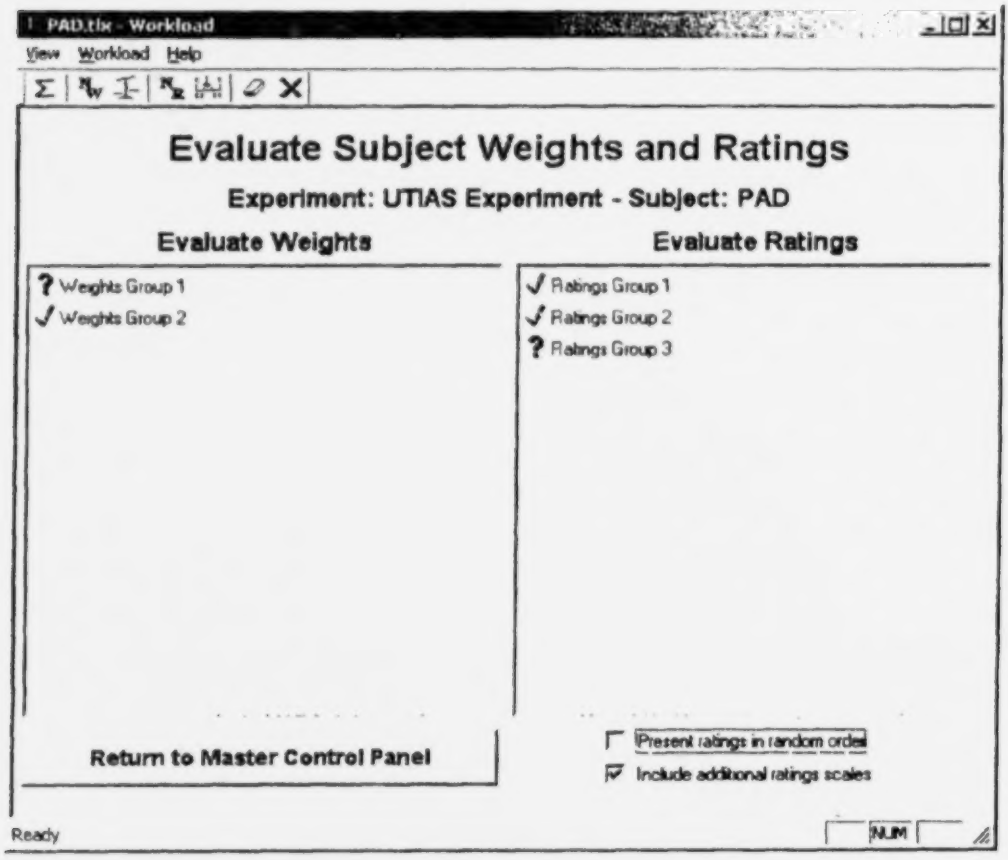


Figure 3. The Evaluate Subject Weights and Ratings window.

Once the Subject Evaluation window is opened, headings near the top of the window will indicate that you are in the Subject Evaluation window, and will tell you which experiment and subject is currently being evaluated. The main heading appears in green, which is the colour-code for subject-oriented tasks.

To leave the Subject Evaluation window and return to the **Master Control Panel**, click the button entitled **Return to Master Control Panel** at the lower right of the window.

The Subject Evaluation window is separated into two panes, one on the left for **Weights** and one on the right for **Ratings**. There will generally be one entry in each list for each weights and ratings evaluation that the given subject must perform. Those evaluations not yet completed will have a red question mark to their left, while those that have been completed will have a green check mark.

The Subject Evaluation window is intended for recording weights and ratings data from subjects, but it also provides the facility for you to create, edit the names of, and delete, both weights and ratings for this individual subject. Each of these functions is invoked by choosing an entry in **Workload** menu at the top left of the window, or by clicking the corresponding toolbar button. (The toolbar is hidden by default in the Subject Evaluation window. To make it visible, choose the **Toolbar** entry in the **View** menu. To find out what each toolbar button does, hold the mouse pointer over it for a second and a tool tip will appear indicating its function, with a longer description appearing in the status bar at the bottom of the window.) As noted earlier, you will generally define the Weights and Ratings for an experiment using the Template Editor before creating any subjects for the experiment. When subjects are created later, all the contents of the experiment template are copied into new subject profiles. If you do make a change from the Subject Evaluation window (such as creating, renaming, or deleting a Weights or Ratings entry), you will be notified that the change applies to this subject only, and will not be propagated to the experiment template or to other subjects.

The following sub-sections describe each of these tasks in greater detail.

5.1 Weights

Each weights entry is associated with one or more experimental conditions, for which each subject will be required to make a series of pair-wise comparisons between the relative importance of the six TLX factors in describing the difficulty of the experimental tasks.

5.1.1 Evaluating weights

Each subject evaluates the relative importance of each of the TLX scales through a dialog window as it cycles randomly through all of the unique pairs of scales.

To begin the evaluation of a set of weights for a subject

1) Select the weights to be evaluated in the **Weights** list.

2) Choose the **Evaluate Weights** entry in the **Workload** menu, click the corresponding button in the toolbar (the one with a picture of a balance), or alternately, double-click on the entry in the **Weights** list. The function will be enabled only if there is exactly one entry selected in the **Weights** list.

3) A new **Evaluate Workload Weights** dialog will open (hereafter the Weights Evaluation dialog), titled with the name of the weights group being evaluated, and asking the question "Which factor was most important?". Below the question, the names of two of the six TLX ratings scales will appear on two large rectangular buttons on the left, with the defining question for the two scales to the right. The two large buttons define the two scales being compared (Figure 4).

4) The subject should be instructed to carefully read the defining question for each of the two scales, and to click the button corresponding to the scale considered most important or relevant for the experimental tasks to which this weights group applies.

5) Once the subject has clicked one of the buttons it will become depressed, and its title will become underlined and will appear as the answer to the question. The subject can click the other button to change the selection.

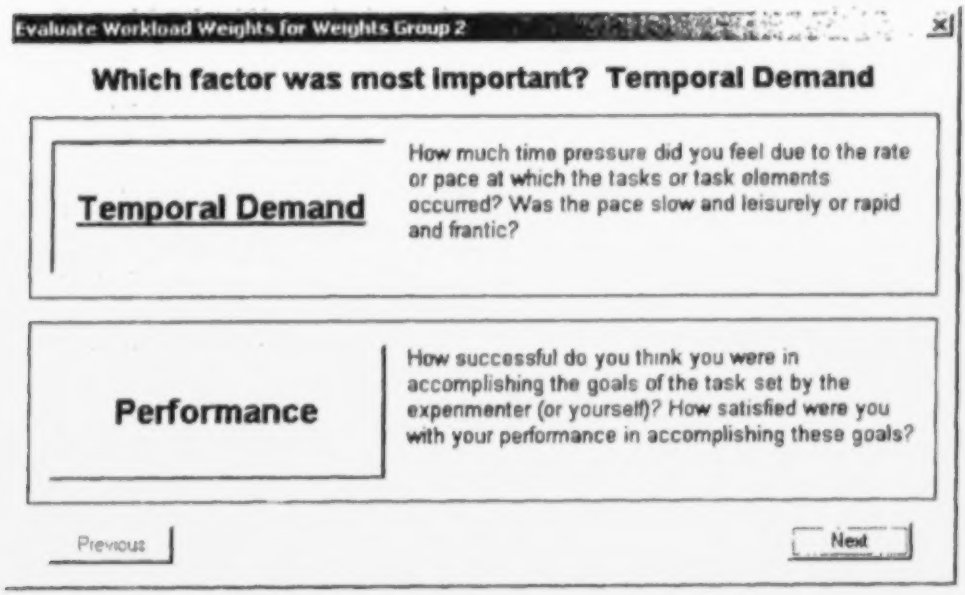

Evaluate Workload Weights for Weights Group 2
Which factor was most important? Temporal Demand
Temporal Demand
How much time pressure did you feel due to the rate or pace at which the tasks or task elements occurred? Was the pace slow and leisurely or rapid and frantic?
Performance
How successful do you think you were in accomplishing the goals of the task set by the expenmenter (or yourself)? How satisfied were you with your performance in accomplishing these goals?
Previous
Next

Figure 4. The Evaluate Workload Weights dialog.

6) Once one comparison has been made, the **Next** button at the lower right of the dialog will become enabled. The subject can click this button to proceed with the next comparison. Alternately, the subject may simply double-click on the selected scale button, and the dialog will register the choice and advance to the next comparison automatically. Subjects may return to previously completed paired-comparison dialogue boxes using the **Previous** button until step (7) is complete.

7) Once the subject completes the last of the comparisons, the text on the **Next** button will change to **Finish**, and the subject can click this button to complete the evaluation. This will happen automatically if the subject double-clicks his or her selection. This will close the Weights Evaluation dialog, save the results, and return control to the Subject Evaluation window.

The subject can also click the **Previous** button to go backward and review or change the selections he or she has already made at any time during the evaluation. Note that if the subject clicks the dialog's Close button (the small X in the upper right corner), they will be prompted to indicate whether or not they wish to abort the evaluation session. The default is no. If they answer yes, control will return immediately to the Subject Evaluation window and results from the entire Weights Evaluation dialog will be discarded.

You do not need to explicitly save the data recorded from a subject while using the Evaluate Weights dialog. The software does this automatically each time an action is completed.

5.1.2 Creating new Weights

1) To create a new weights entry for an individual subject, choose **New Weights Group** from the **Workload** menu, or click the corresponding toolbar button (the one titled $^{N}_{W}$).

2) A new entry will appear in the **Weights** list, with a red question mark beside it to indicate it is incomplete, and with highlighted text prompting you to enter a name for this set of weights. Enter a new name.

3) Press the **Enter** key to accept the name, or the **Escape** key to abort creation of the weights entry.

5.1.3 Deleting Weights

The Delete entry in the Workload menu and its corresponding toolbar button (a red X) will become enabled if at least one Weights entry is selected in the lists of weights or ratings. To delete one or more weights entries

1) Select one or more weights entries that you would like to delete. Hold the **Shift** key down to select a range of weights, or the **Ctrl** key to select multiple weights one at a time.

2) Choose **Delete** from the **Workload** menu or click the toolbar button (a red **X**).

3) You will be prompted for confirmation before the entry is deleted.

5.1.4 Erasing Weights

Erasing a Weights entry clears the subject's recorded data without removing the entry from the list, and thus changes the icon for the entry from a green check mark back to a red question mark. The Erase entry in the Workload menu and its corresponding icon in the toolbar (a picture of an eraser) will only be enabled if there is at least one completed weights or ratings entry selected. To erase the recorded data from one or more of a subject's completed weights entries

1) Select one or more weights entries that you would like to erase. Hold the **Shift** key down to select a range of weights, or the **Ctrl** key to select multiple weights one at a time.

2) Choose **Erase** from the **Workload** menu or click the toolbar button (a picture of an eraser).

3) You will be prompted for confirmation before the data is erased.

5.2 Ratings

Each Ratings entry is usually associated with an experimental condition that each subject will assess on each of the TLX scales.

5.2.1 Evaluating ratings

Subjects rate the experimental conditions through a dialog box that cycles through all of the required rating scales in turn, usually in random order if this has been requested by checking the **Present ratings in random order** checkbox. There will be either six or nine scales, depending on whether the additional three scales have been requested via the **Include additional rating scales** checkbox.

To begin the evaluation of a set of ratings for a subject

1) Select the ratings to be evaluated in the **Ratings** list.

2) Choose **Evaluate Ratings** from the **Workload** menu, click the corresponding toolbar button (the one with a picture of a rating scale), or alternately, double-click on the entry in the **Ratings** list. The function will be enabled only if there is exactly one entry selected in the **Ratings** list.

3) A new **Evaluate Workload Ratings** dialog (hereafter Ratings Evaluation dialog) will open, titled with the name of the ratings group being evaluated, and asking the question "How would you rate this factor?". Below the question, the name of one of the rating scales will appear on the left, with its corresponding defining question on the right. Below these will appear a slider bar with two extreme answers to the question on its left and right (Figure 5).

4) The subject should be instructed to carefully read the defining question for the rating scale, and to move the pointer for the slider bar (click-and-drag) from its position at the extreme left to the location that best reflects the perceived rating between the two extremes. Alternately, the subject may click once on the slider bar at the desired location to move the pointer there. The subject can move the pointer to change the rating.

5) Once the pointer has been moved, the **Next** button at the lower right of the dialog will become enabled. The subject can click this button to proceed with the next rating evaluation. Alternately, the subject may double-click at the desired location on the slider bar to move the indicator and proceed to the next rating in one step. The subject can click the **Previous** button to go backward and review or change ratings any time during the evaluation before completing the next step (6).

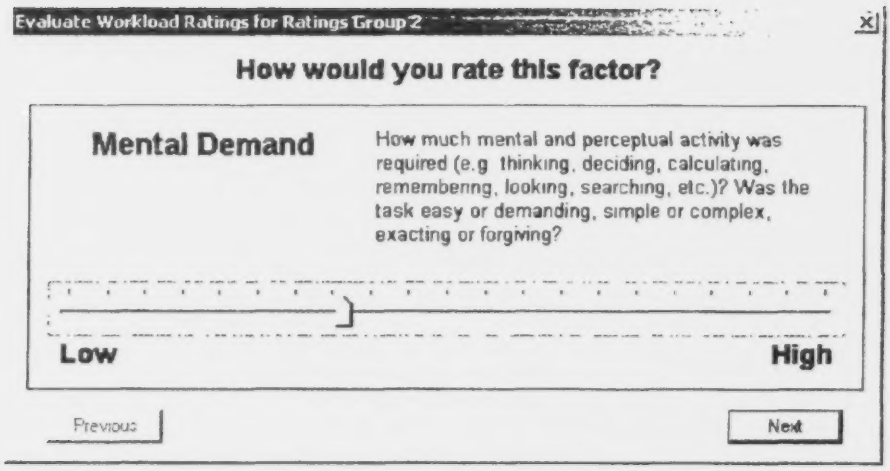

Evaluate Workload Ratings for Ratings Group 2
How would you rate this factor?
Mental Demand
How much mental and perceptual activity was required (e.g thinking, deciding, calculating, remembering, looking, searching, etc.)? Was the task easy or demanding, simple or complex, exacting or forgiving?
Low
High
Previous
Next

Figure 5. The Evaluate Workload Ratings dialog.

6) Once the subject reaches the last of the ratings, the text on the **Next** button will change to **Finish**, and the subject can click this button to complete the evaluation. This will happen automatically if the subject double-clicks their response. This will close the Ratings Evaluation dialog, save the results, and return control to the Subject Evaluation dialog.

Note that if the subject clicks the dialog's Close button (the small X in the upper right corner), they will be prompted to indicate whether or not they wish to abort the evaluation session. The default is no. If they answer yes, control will return immediately to the Subject Evaluation window and results from the Ratings Evaluation dialog will be discarded.

You do not need to explicitly save the data entered by the subject during the ratings evaluation. The software does this automatically each time an evaluation is completed.

5.2.2 Creating new Ratings

To create a new Ratings entry for a subject

1) Choose **New Ratings** from the **Workload** menu, or click the corresponding toolbar button (the one titled $^{N}_{R}$).

2) A new entry will appear in the **Ratings** list, with a red question mark beside it to indicate it is incomplete, and with highlighted text prompting you to enter a name for this set of ratings. Enter a new name.

3) Press the **Enter** key to accept the name, or the **Escape** key to abort creation of the ratings entry.

5.2.3 Deleting ratings

The Delete entry in the Workload menu and its corresponding toolbar button (a red X) will become enabled if at least one ratings entry is selected in the lists of weights and ratings. To delete one or more ratings entries

1) Select one or more ratings entries that you would like to delete. Hold the **Shift** key down to select a range of ratings, or the **Ctrl** key to select multiple ratings one at a time.

2) Choose **Delete** from the **Workload** menu or click the toolbar button (a red **X**).

3) You will be prompted for confirmation before the entry is deleted.

5.2.4 Erasing ratings

Erasing a Ratings entry clears the subject's recorded data without removing the entry from the list, and thus changes the icon for the entry from a green check mark back to a red question mark. The Erase entry in the Workload menu and its corresponding icon in the toolbar (a picture of an eraser) will only be enabled if there is at least one completed weights or ratings entry selected. To erase the recorded data from one or more of a subject's completed ratings entries

1) Select one or more ratings entries that you would like to erase. Hold the **Shift** key down to select a range of ratings, or the **Ctrl** key to select multiple ratings one at a time.

2) Choose **Erase** from the **Workload** menu or click the toolbar button (a picture of an eraser).

3) You will be prompted for confirmation before the data is erased.

5.2.5 Optional ratings properties

These settings are described in detail in Section 4.2.4. They can only be changed from the Template Editor, and appear in the Evaluation Window for informational purposes only. If you try to change them from the Evaluation Window, a warning message will notify you of this fact.

6 Viewing And Saving The TLX Score And Summary Data

The **View Subject Weights and Ratings** window (hereafter the Subject Viewer window) provides the means for you to compute and view the TLX score and summary data for a subject without changing any of the recorded data. For instructions on opening the Subject Viewer window, see Section 3.2.3.

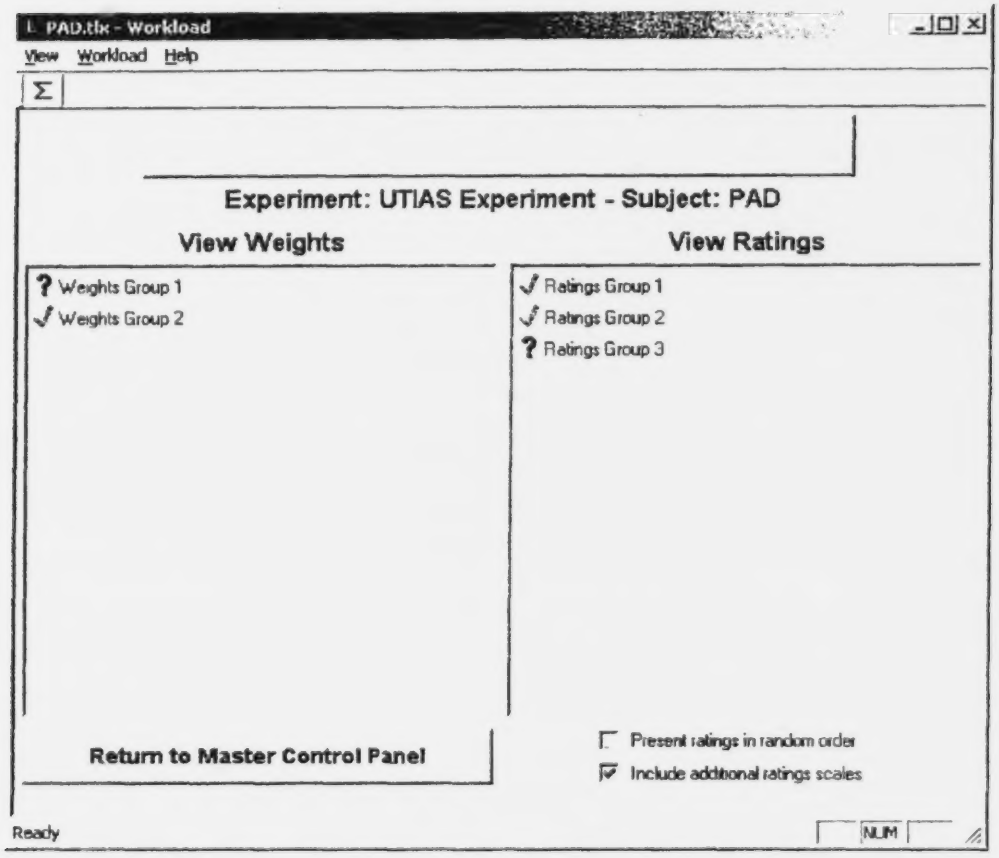


Figure 6. The View Subject Weights and Ratings window.

Once the Subject Viewer window is opened, headings near the top of the window will indicate that you are in the Subject Viewer window, and will indicate which experiment and subject is currently being viewed. The main heading appears in yellow, to

differentiate this window from the Template Editor and Subject Evaluation windows (Figure 6).

To leave the Subject Viewer window and return to the **Master Control Panel**, click the button entitled **Return to Master Control Panel** at the lower right of the window.

Like the Subject Evaluation window, the Subject Viewer window is separated into two panes, one on the left for **Weights** and one on the right for **Ratings**. Those evaluations not yet completed will have a red question mark to their left, while those that have been completed will have a green check mark.

The Workload program provides a number of different ways to review the data collected from any subject. You can choose to review exactly what the subject entered in the same dialogs used to collect the data; compute the TLX score and view it along with the summary data from the subject's selections in the form of weights and ratings scores; you can save these summary data to a text file for later importing into a spreadsheet or statistical analysis program. The steps required for each of these three options are outlined in the following three sub-sections.

NOTE: All of the results viewing and saving functions described in this section are also available in the Subject Evaluation window. The Subject Viewer window provides a subset of the functionality of the Subject Evaluation window.

6.1 Reviewing a subject's entries

To review the choices made by the subject in the original Weights and Ratings Evaluation dialogs in which they were entered

1) Locate the completed weights or ratings entry (those with a green check mark to their left) that you would like to review, and select it.

2) For weights, choose Evaluate Weights from the Workload menu, or click the corresponding toolbar button (the one with a picture of a balance), or alternately, double-click on the entry in the weights list. The function will be enabled only if there is exactly one completed entry selected in the Weights list.

3) The Weights Evaluation dialog will open again, but now the title bar will indicate the date and time at which the subject performed the evaluation, and you will not be allowed to change any of the subject's selections. Note that in this case, the comparisons will appear in a standard order, not in the original random order used during the evaluation.

4) Use the Next button at the bottom right of the dialog to step through each of the comparisons. Its text will change to Finish on the last comparison, and the dialog will close when you click it.

5) For ratings, choose Evaluate Ratings from the Workload menu, or click the corresponding toolbar button (the one with a picture of a rating scale), or alternately, double-click on the entry in the ratings list. The function will be enabled only if there is exactly one completed entry selected in the Ratings list.

6) The Ratings Evaluation dialog will open, but now the title bar will indicate the date and time at which the subject performed the evaluation, and you will not be allowed to move the slider bar. Note that in this case, the rating scales will appear in the standard order, no matter whether a random order was used during the evaluation or not.

7) Use the **Next** button at the bottom right of the dialog to step through each of the rating scales. Its text will change to **Finish** on the last comparison, and the dialog will close when you click it.

6.2 Computing and viewing the TLX score and summary data

Once a completed weights entry in the **Weights** list and/or a completed ratings entry in the **Ratings** list has been selected, the yellow main heading will turn into a button. Clicking this button will compute the TLX score for the selected item(s) and open the View Results dialog, which presents the score in addition to a tabulated account of the subject's responses in the weights and ratings evaluations.

To open the view results dialog

1) Select at most one completed weights entry and/or one completed ratings entry from the **Weights** and **Ratings** lists. You may select only a weights entry or only a ratings entry if you wish.

2) Click the main heading button (the one with yellow text), choose the **View Results** entry from the **Workload** menu, or click the corresponding toolbar button (the one with a Σ).

3) The **View Results** dialog will open, and the name of the experiment and initials of the current subject will appear at the top of the dialog (Figure 7).

4) If a completed weights group was selected, then its name, the date and time of its completion, and the weights computed from the subject's comparisons will appear as well. Otherwise, an equal weighting scheme

will be assumed, the **Weights Name** field will read "Equal Weighting", and the date and actual values for the weights will be disabled (greyed out).

5) Similarly, if a completed ratings entry was selected, then its name, the date and time of its completion, and the ratings themselves (on a scale of 0 – 1000) will appear. Otherwise, the ratings fields will be disabled.

6) Finally, if a ratings entry was selected, then the TLX score will also be computed and displayed using the ratings and either the selected weights if there are any, or the equal weighting scheme if no weights were selected. Otherwise, this field will be disabled.

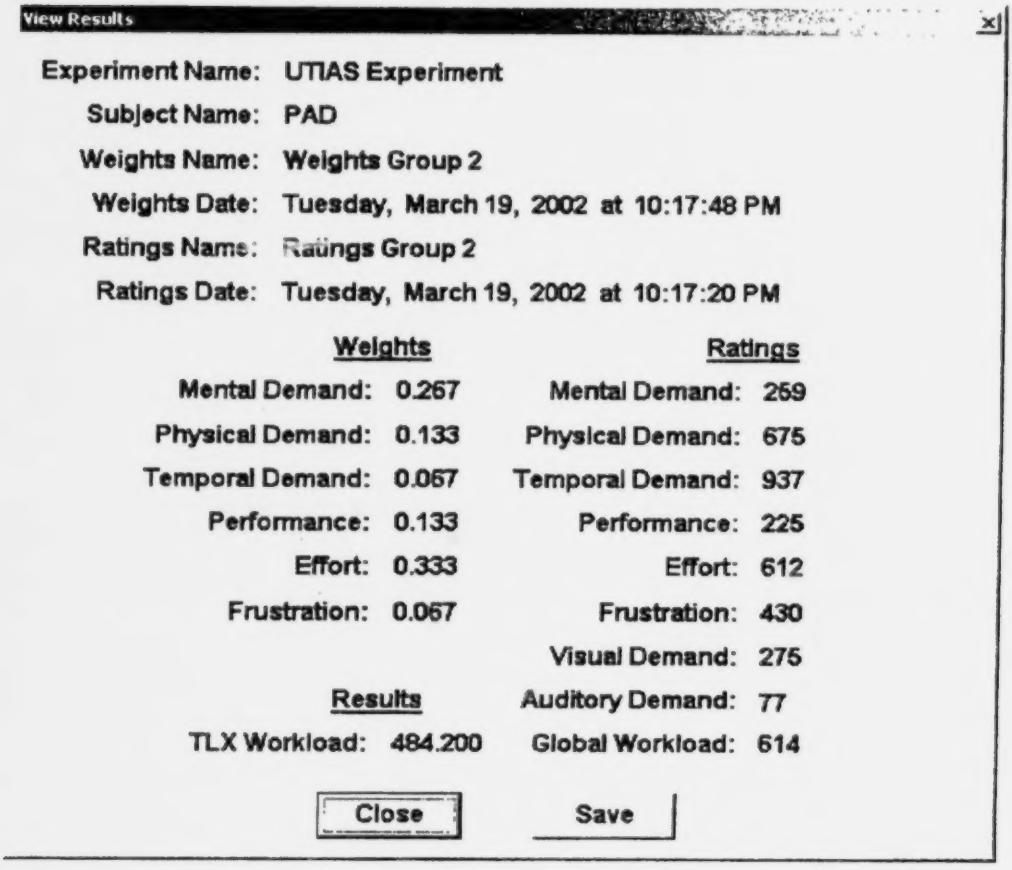


Figure 7. The View Results dialog.

7) To close the **View Results** dialog, click the **Close** button at the lower left. The use of the **Save** button is covered in the next sub-section.

6.3 Saving the TLX score and summary data to a spreadsheet file

If you wish to save the TLX score and summary data to a text file for later analysis, the Workload program provides two different means for accomplishing this goal. One method allows you to save at most one combination of weights and/or ratings to a selected text file at a time, while the other allows you to save many combinations of weights and ratings in one step. Each of these possibilities is described in turn below.

To save the TLX score and summary data from a single combination of weights or ratings to a text file

1) Select at most one weights and/or ratings entry from the **Weights** and **Ratings** lists, respectively.

2) Click the yellow main heading button (or choose **View Results** from the **Workload** menu, or click the Σ toolbar button).

3) Once the **View Results** dialog is open, click the **Save** button at the lower right.

4) The **Save Results To Text File Dialog** will open (Figure 8). This dialog is identical to the standard Windows dialog used to open and save files in other programs, with the addition of a Preview pane that allows you to view the contents of a file before deciding to save your results into it. You can navigate up and down through directories in the usual way, and the dialog will display any text files (files with names ending in .txt) in the current directory. Use the dialog to select the directory in which you would like the file saved.

5) You can type in a new file name if you wish to begin a new text file for outputting results to a spreadsheet or statistical program. If the file whose name you enter does not yet exist, a prompt in bold text will inform you that a new file with the name you specified will be created. In this case, a set of headings will be written to the first line of the file, and the TLX score and summary data will be written to the second line.

6) Alternately, if you wish to append the results to the end of an existing file, then simply select the file in the upper pane of the dialog, or type in its name. The current contents of the file will appear in the lower pane of the dialog, and a prompt in bold text will inform you that results will be appended to the end of this file.

7) Once you have specified a new file name or selected an existing file, click the **Save** button to save the results, or the **Cancel** button to abort.

You can also choose to save multiple weights or ratings entries at once. Using this technique, each individual weights entry that you have selected in the **Weights** list, plus the default equal weighting scheme, will be combined with each individual ratings entry that you have selected from the **Ratings** list, and a single line of summary statistics will be written to the selected output file for each combination. Thus, if you select two weights entries and 3 ratings entries, for example, this will produce (2 + 1) x 3 = nine lines of output data in the selected text file.

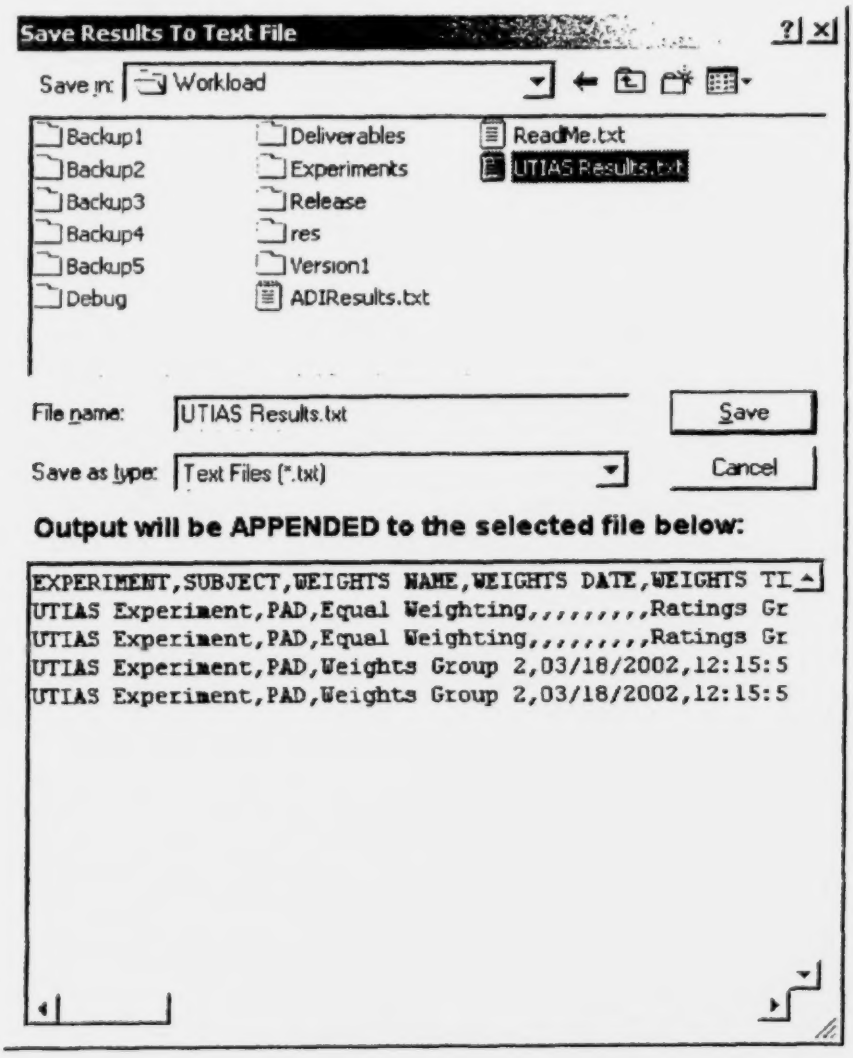


Figure 8. The Save Results To Text File Dialog.

To save the TLX score and summary data from multiple weights or ratings entries at once as described above:

1) Select all of the weights and/or ratings entries that you would like saved in the **Weights** and **Ratings** lists, respectively. You can select a range of entries in either list by holding down the **Shift** key, or select multiple items one at a time by holding down the **Ctrl** key.

2) Click the yellow main heading button (or choose **View Results** from the **Workload** menu, or click the Σ toolbar button). The **Save Results To Text File** dialog will open immediately (Figure 8), bypassing the **View Results** dialog, since the **View Results** dialog can only accommodate one combination of weights and/or ratings at a time.

3) The **Save Results To Text File** dialog is identical to the standard Windows dialog used to open and save files in other programs, with the addition of a Preview pane that allows you to view the contents of a file before deciding to save your results into it. You can navigate up and down through directories in the usual way, and the dialog will display any text files (files with names ending in .txt) in the current directory. Use the dialog to select the directory in which you would like the results file saved.

4) You can type in a new file name if you wish to begin a new text file for outputting results to a spreadsheet or statistical program. If the file whose name you enter does not yet exist, a prompt in bold text will inform you that a new file with the name you specified will be created. In this case, a set of headings will be written to the first line of the file, and each combination of summary results will be written to subsequent lines.

5) Alternately, if you wish to append the results to the end of an existing file, then simply select the file in the upper pane of the dialog, or type in its name. The current contents of the file will appear in the lower pane of the dialog, and a prompt in bold text will inform you that results will be appended to the end of this file.

6) Once you have specified a new file name or selected an existing file, click the **Save** button to save the results, or the **Cancel** button to abort.

The output format of the results text is designed to be compatible with spreadsheet software such as Microsoft Excel™. It is arranged as a set of 24 text items separated by commas on a single line, corresponding to all of the items in the **View Results** dialog (Figure 7). The following steps describe how to load a Workload-generated text file into Excel – the procedure is similar for other programs.

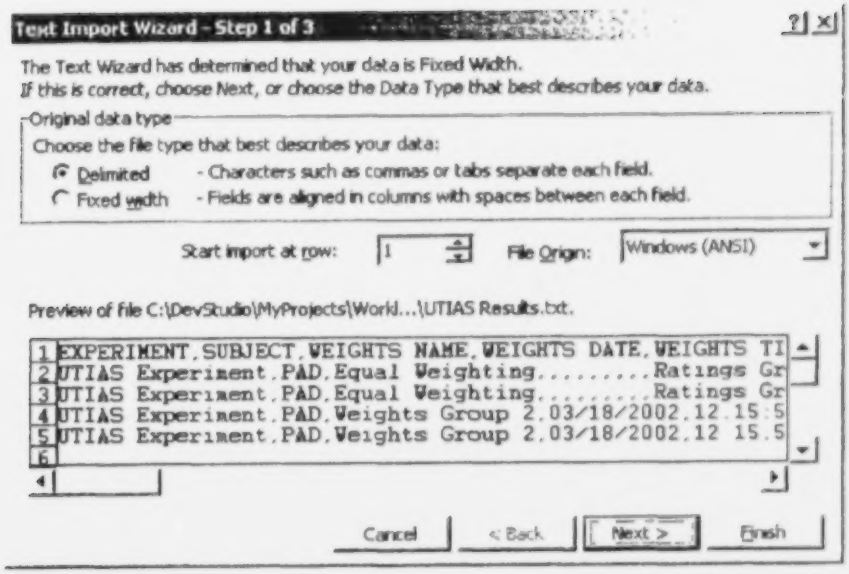
To load the results from a text file into Excel

1) Locate the file from inside Excel as you would any other Excel file. If the file does not appear in its directory in Excel's Open dialog, make sure the **Files of type** filter at the bottom of the dialog is set to Text Files.

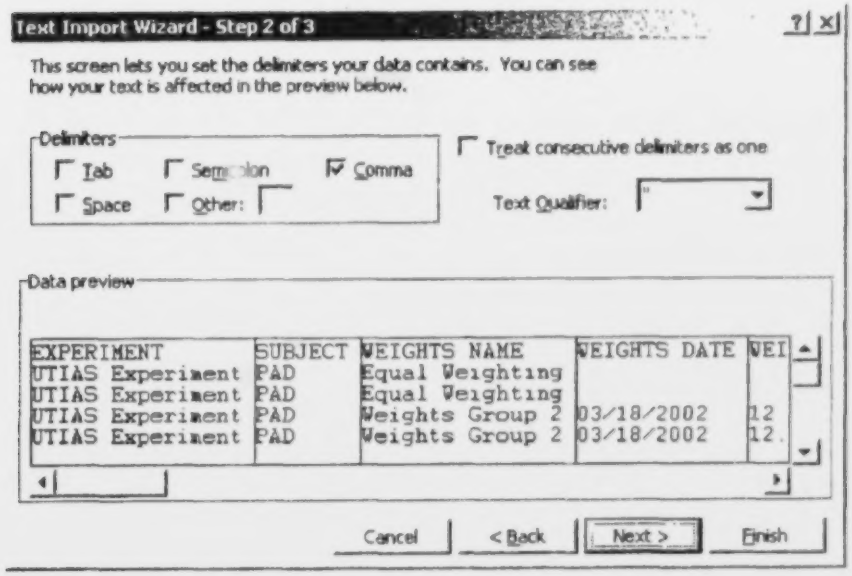
2) To open the file, double-click on the file's name in the dialog or click once to select it and then click Open.

3) This will open Excel's **Text Import Wizard**, which will prompt you to make certain selections concerning the format of the file. You should indicate that the file is delimited, and that the delimiter is a comma (Figure 9a and b).

4) The file should then open as a worksheet with all of the data items in fields under their respective headings. Fields for unavailable items will be empty (for example, if you are saving only weights and not ratings). You may need to widen some columns before their contents will be visible.


Text Import Wizard - Step 1 of 3
The Text Wizard has determined that your data is Fixed Width.
If this is correct, choose Next, or choose the Data Type that best describes your data.
Original data type
Choose the file type that best describes your data:
Delimited - Characters such as commas or tabs separate each field.
Fixed width - Fields are aligned in columns with spaces between each field.
Start import at row: 1
File Origin: Windows (ANSI)
Preview of file C:\DevStudio\MyProjects\World...\UTIAS Results.txt.
1 EXPERIMENT,SUBJECT,WEIGHTS NAME,WEIGHTS DATE,WEIGHTS TI
2 UTIAS Experiment,PAD,Equal Weighting.....Ratings Gr
3 UTIAS Experiment,PAD,Equal Weighting.....Ratings Gr
4 UTIAS Experiment,PAD,Weights Group 2,03/18/2002,12 15:5
5 UTIAS Experiment,PAD,Weights Group 2,03/18/2002,12 15.5
6
Cancel
< Back
Next >
Finish

(a)


Text Import Wizard - Step 2 of 3
This screen lets you set the delimiters your data contains. You can see how your text is affected in the preview below.
Delimiters
Tab
Semicolon
Comma
Space
Other:
Treat consecutive delimiters as one
Text Qualifier:
Data preview
EXPERIMENT SUBJECT WEIGHTS NAME WEIGHTS DATE WEI
UTIAS Experiment PAD Equal Weighting
UTIAS Experiment PAD Equal Weighting
UTIAS Experiment PAD Weights Group 2 03/18/2002 12
UTIAS Experiment PAD Weights Group 2 03/18/2002 12.
Cancel
< Back
Next >
Finish

(b)

Figure 9. The Microsoft Excel Text Import Wizard: (a) Step 1; (b) Step 2.

DOCUMENT CONTROL DATA SHEET

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13 DOCUMENT ANNOUNCEMENT Unlimited announcement		

14 ABSTRACT

(U) The NASA Task Load Index (TLX) provides a standard and widely used protocol for assessing a subject's perceptions of the difficulty they experienced while performing experimental tasks. The index is defined in terms of six rating scales that decompose the difficulty subjects experienced along different psychological axes. The TLX protocol as originally developed called for a paper-and-pencil evaluation to collect the information necessary for computation of the index. A more convenient DOS-based program written in Turbo Pascal automated the original version, providing a simple user interface. This guide describes a new implementation of this software, designed to run under recent versions of the Microsoft WindowsTM operating systems, augmented with several new features to help organize and simplify the collection of TLX data. Data may be saved to a comma-separated variable text file for further processing. Three additional, optional rating scales may be selected to provide greater diagnostic assessment than that available from the original method. These scales include ratings for the Visual and Auditory demands as well as an overall workload perception.
The program is functional but should still be considered under development. It provides DRDC with a tool to quickly record NASA TLX subjective ratings from subject matter experts or test subjects using a laptop computer and a mouse, then save the results in a format suitable for analysis in spreadsheets or statistical packages.

(U) L'indice de charge de tâches (TLX) de la NASA constitue un protocole normalisé et largement utilisé pour l'évaluation des perceptions de la difficulté éprouvée par des sujets dans l'exécution de tâches expérimentales. L'indice est défini en fonction de six échelles d'évaluation qui décomposent la difficulté éprouvée par les sujets selon différents axes psychologiques. Dans le protocole TLX élaboré initialement, on devait effectuer une évaluation avec un crayon et du papier pour recueillir les données nécessaires au calcul de l'indice. La version initiale a par la suite été remplacée par un programme DOS plus pratique écrit en Turbo Pascal, qui offrait une interface utilisateur simple et automatisait les calculs. Le présent guide sommaire décrit la prochaine génération de ce logiciel, conçu pour tourner sur les plus récentes versions du système d'exploitation Microsoft WindowsTM et comprenant plusieurs nouvelles options destinées à simplifier l'organisation et la collecte des données relatives à l'indice TLX. Les données peuvent être sauvegardées dans un fichier? texte de variables séparées par une virgule en vue d'un traitement ultérieur.
Trois échelles d'évaluation additionnelles peuvent être sélectionnées en option pour permettre une évaluation diagnostique supérieure à celle qui peut être effectuée avec la méthode originale. Ces échelles comprennent des évaluations de l'effort visuel et de l'effort auditif ainsi que de la perception de la charge de travail globale.
Le programme est en état de service mais il devrait être considéré comme étant encore en phase de développement. Il fournit à RDDC un outil permettant d'enregistrer rapidement des évaluations subjectives de l'indice TLX de la NASA fournies par des experts en la matière ou des sujets soumis à des tests, à l'aide d'un ordinateur portatif et d'une souris, puis de sauvegarder les résultats dans un format approprié pour l'analyse dans des tableurs ou des logiciels statistiques.

15 KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) mental workload; cognitive workload; measurement; NASA TLX

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